EXHIBIT W

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF TEXAS
SAN ANTONIO DIVISION

LINDA JANN LEWIS, MADISON LEE, ELLEN SWEETS, BENNY ALEXANDER, GEORGE MORGAN, VOTO LATINO, TEXAS STATE CONFERENCE OF THE NATIONAL ASSOCIATION FOR THE ADVANCEMENT OF COLORED PEOPLE, and TEXAS ALLIANCE FOR RETIRED AMERICANS,

Plaintiffs,

v.

RUTH HUGHS, in her official capacity as Texas Secretary of State, Defendants.

Civil Case No. 5:20-cv-00577

Related to *Gloria et al. v. Hughs et al.*, No. 5:20-cv-00527

DECLARATION OF DR. LINTON A. MOHAMMED

LINTON A. MOHAMMED, acting in accordance with 28 U.S.C. § 1746, Federal Rule of Civil Procedure 26(a)(2)(B), and Federal Rules of Evidence 702 and 703, does hereby declare and say:

1. I am a Forensic Document Examiner ("FDE"), certified by the American Board of Forensic Document Examiners. I have been engaged in this matter on behalf of Plaintiffs Linda Jann Lewis, Madison Lee, Ellen Sweets, Benny Alexander, George Morgan, Voto Latino, Texas State Conference of the National Association for the Advancement of Colored People, and the Texas Alliance For Retired Americans, to opine on the reliability of the procedures and techniques of the Texas signature verification process for mail-in ballot applications and mail-in ballot return envelopes as set forth in Texas elections laws and guidance.

I. QUALIFICATIONS

2. I am a U.S.-certified and internationally recognized FDE, and the focus of my research and professional experience is on handwriting and signature identification and the scientific approach to analyzing questioned signatures. I am, and since 1998 continuously have been,

certified by the American Board of Forensic Document Examiners (ABFDE), a certifying board for FDEs in North America. I am also certified in document examination by the Chartered Society of Forensic Sciences (United Kingdom). I specialize in the forensic science of analyzing genuine, disguised, and simulated signatures.

3. I co-founded and I am currently the principal at Forensic Science Consultants, Inc., where I conduct forensic document examination casework and research on handwriting and signature examination as well as other forensic document examination (e.g., document alterations, obliterations, indented impressions, or pages added or removed). I am also an adjunct professor at Oklahoma State University, where I teach graduate courses on the scientific examination of questioned documents.

4. During and prior to my time with Forensic Science Consultants, Inc., and for nearly fourteen years, I worked as Forensic Document Examiner and Senior Document Examiner for the San Diego Sherriff's Department Regional Crime Laboratory. There, I conducted examinations of signatures and handwriting for cases investigated by San Diego County agencies as well as by local police, state, and federal agencies. I also served as Technical Lead of the Questioned Documents Section of the Regional Crime Laboratory, trained investigators and attorneys, provided expert testimony, conducted research, and produced the Questioned Documents Section Quality Manuals. Prior to that, I worked internationally as an FDE at the Laboratory of the Government Chemist (England), the Caribbean Institute of Forensic Investigations Ltd. (West Indies), and the Trinidad and Tobago Forensic Science Center (West Indies). In those roles, I conducted forensic document examinations and testified in criminal and civil cases for multiple police forces and other government agencies.

5. I am a Fellow of the Questioned Documents Section of the American Academy of Forensic Sciences (AAFS), a Fellow and diplomate of the Chartered Society of Forensic Sciences, and a member of the Canadian Society of Forensic Science. I served as the Chair of the AAFS Questioned Documents Section from 2016 to 2018. I am an appointed member and Vice Chair of the Academy Standards Board, which was formed by the AAFS to develop documentary standards for the forensic sciences. I served as a member of the National Institute of Standards and Technology's Expert Working Group on Human Facts in Handwriting Examination, the National Institute of Standards and Technology Organization of Scientific Area Committees' Physics/Pattern Interpretation Scientific Area Committee, and the Scientific Working Group on Documents. I have previously served as President, Vice President, Treasurer, and Director of the American Society of Questioned Document Examiners (ASQDE).

6. I am the editor of the Journal of the American Society of Questioned Document Examiners. I am an editorial review board member of Forensic Science and Technology and I served on the editorial review board of the Journal of Forensic Sciences from 2005-2020. I am also a guest reviewer for the following journals: Forensic Science International, Science & Justice, Australian Journal of Forensic Science, Egyptian Journal of Forensic Sciences, and IEEE Transactions on Cybernetics.

7. I have published sixteen articles on signature and handwriting examination, and forensic document examination. Many of my articles focus on the analysis of genuine and forged signatures and handwriting examination. I have also given numerous presentations and workshops on signature and document examination worldwide, including the United States, Australia, Brazil, Canada, China, Latvia, Poland, Portugal, Saudi Arabia, Scotland, and Turkey.

8. In 2019, I authored a book titled, *Forensic Examination of Signatures* which describes and discusses state of the art techniques and research in signature examination.[1] I co-authored a book in 2012 titled *The Neuroscience of Handwriting: Applications for Forensic Document Examination*, which integrates research in the fields of motor control, neuroscience, kinematics, and robotics to evaluate questioned signatures and handwriting.[2] The book sets forth, among other things, the scientific fundamentals of motor control as relevant to handwriting; the impact of age, disease, and medication on handwriting; and a quantitative approach to signature authentication, including kinematic and laboratory analyses of genuine versus disguised versus forged signatures.

9. In 2012, I received the American Board of Forensic Document Examiners' New Horizon Award "In Recognition of His Exceptional Contributions in Scientific Research for the Advancement of Forensic Document Examination." In 2019, I received the American Academy of Forensic Sciences Questioned Documents Section Ordway Hilton Award "In Recognition of Outstanding Contributions to Forensic Document Examination."

10. I have testified as an expert witness in court and depositions more than 150 times on issues of signature, handwriting, and document examination in both civil and criminal cases, including cases in the United States, England, Trinidad & Tobago, and St. Vincent.

11. I received a Ph.D. from La Trobe University in Melbourne, Australia in human biosciences, where I wrote my thesis on signature examination: "*Elucidating static and dynamic features to discriminate between signature disguise and signature forgery behavior*." Prior to that, I received my undergraduate degree in science at the University of West Indies; underwent a two-year training program in document examination at the Trinidad and Tobago Forensic Science

[1] Mohammed, L. (2019). *Forensic Examination of Signatures*. San Diego: Elsevier.

[2] Caligiuri, M.P., & Mohammed, L.A. (2012). *The Neuroscience of Handwriting: Applications for Forensic Document Examination.* Boca Raton: CRC Press/Taylor & Francis Group.

Center; and received a master's degree in forensic sciences at National University in San Diego, California.

12. My *curriculum vitae* is attached as Exhibit A, and a Testimony Listing for the past five years is attached as Exhibit B. I am being compensated at a rate of $400.00 per hour. My compensation in this matter is not in any way contingent on the content of my opinion or the outcome of this matter.

II. BACKGROUND

13. For this Declaration, I reviewed the Plaintiff's Original Complaint filed in this matter; Vernon's Texas Statutes and Codes Annotated Election Code § 87.027, the State of Texas Early Voting Ballot Board & Signature Verification Committee Handbook for Election Judges and Clerks 2020, and relevant academic literature.

14. Based on my review of the Complaint in this lawsuit, the laws challenged therein, § 87.027 of the Texas Election Code, and the State of Texas Early Voting Ballot Board & Signature Verification Committee Handbook for Election Judges and Clerks 2020, I understand that a group of election officials known as the Signature Verification Committee (SVC) compares the signatures on mail-in ballot applications and mail-in ballot return envelopes. § 87.027 (1, 1-a).

15. According to § 87.027 (i), "[t]he signature verification committee shall compare the signature on each carrier envelope certificate, except those signed for a voter by a witness, with the signature on the voter's ballot application to determine whether the signatures are those of the voter."

16. Under that same provision, "[t]he committee may also compare the signatures with any two or more signatures of the voter made within the preceding six years and on file with the county

clerk or voter registrar to determine whether the signatures are those of the voter." These signatures may be either "wet" or electronic.

17. § 87.027 (j) states, "If a signature verification committee is appointed, the early voting ballot board shall follow the same procedure for accepting the early voting ballots voted by mail as in an election without a signature verification committee, except that the board may not determine whether a voter's signatures on the carrier envelope certificate and ballot application are those of the same person if the committee has determined that the signatures are those of the same person. If the committee has determined that the signatures are not those of the same person, the board may make a determination that the signatures are those of the same person by a majority vote of the board's membership."

18. Neither the statutes governing the signature matching process nor State of Texas Early Voting Ballot Board & Signature Verification Committee Handbook for Election Judges and Clerks 2020 provide any guidance to elections officials on how to compare signatures.

19. Based on my understanding, Texas election officials are lay individuals, meaning they are not required to have any training, certification, or experience in document examination or signature comparison.

20. Based on my understanding, there are no further written statewide standards or procedures for election officials to evaluate whether a signature on a mail-in ballot application or ballot return envelope match each other, or match a signature in the qualified voter file or on a voter registration card.

III. SUMMARY OF CONCLUSIONS

21. The Texas signature match procedures do not set forth sufficient standards for determining whether a signature on a mail-in ballot application or return envelope match each

other or match a voter signature displayed in the qualified voter file or on the voter's registration card, which results in error-prone determinations. Based on my review of the election statutes and the State of Texas Early Voting Ballot Board & Signature Verification Committee Handbook for Election Judges and Clerks 2020, Texas also does not require election officials to have any training in signature examination and does not require that election officials be provided examination equipment, such as proper light sources and microscopes.

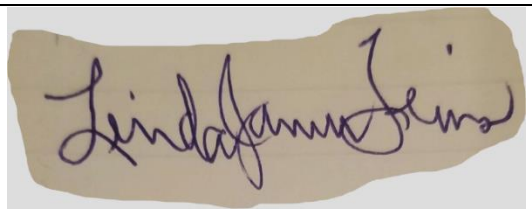
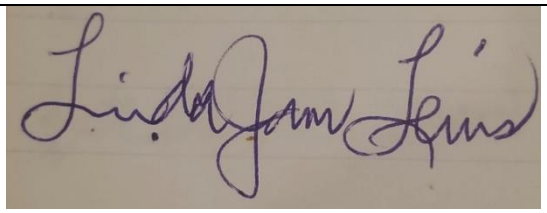
22. Based on my experience and my review of the academic literature, it is my opinion that in these circumstances, Texas election officials are likely to make erroneous signature comparison determinations.

23. Determining whether a signature is genuine is a difficult task for even a trained FDE, as signatures are written in different styles with varying levels of readability and variability. Laypersons, which include Texas election officials, have a significantly higher rate of error than trained individuals in determining whether signatures are genuine. In particular, laypersons are more likely to wrongly determine that authentic signatures are *not* genuine than to make the opposite error. In other words, Texas election officials are significantly more likely than trained individuals to make an incorrect signature-comparison determination and are particularly likely to incorrectly decide that the signatures are *not* signed by the same person.

24. The high rate of error among laypersons generally results from the inability to distinguish between normal "variations" in an individual's signatures as opposed to "differences" resulting from multiple signers. An individual's signatures may vary for myriad reasons, including age, health, native language, and writing conditions.

25. For example, Plaintiff Linda Jann Lewis, age 73, suffers from keratoconus, which impacts her vision. Her changing vision status may have a deleterious effect on her signature, and

increase her range of variation widely. Two of Ms. Lewis's signatures written on the same day (Figure 1) exhibit wide variation, and could be interpreted by a layperson as signatures written by different writers.

JUNE 19, 2020	JUNE 19, 2020
	

26. As another example, Plaintiff Madison Lee, age 23, suffers from rheumatoid arthritis. Her signature on her Driver's License, issued in 2018 (when she was 21), and her signature on her Voter Registration Certificate, valid from 01/01/2020 to 12/31/2021, are illustrated in Figure 2. Although there is some variation between the writer's signatures, that is attributable to her age and illness, and the fact that one signature is written on a line and the other is not.

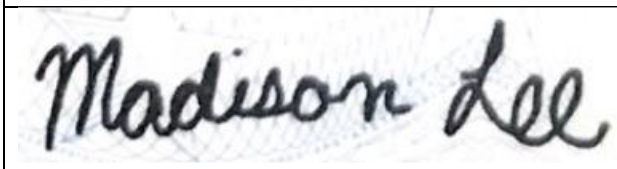
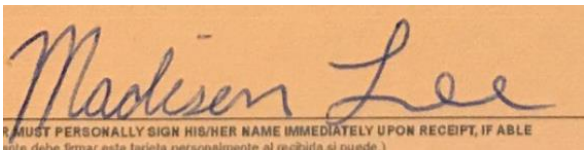
TEXAS DRIVER LICENSE 01/14/2018	VOTER REGISTRATION CERTIFICATE 01/01/2020
	

FIGURE 2 *Signatures of Madison Lee written approximately two years apart.*

27. Laypersons lack the tools and training to properly account for such signature variation, which leads to erroneous mismatch determinations that are particularly pronounced in populations with greater signature variability, such as the elderly, disabled, individuals suffering from poor health, young voters (18-21), and non-native English speakers.

28. These signature-determination errors are further compounded in individuals with diminished eyesight or "form blindness" (a type of impairment in visual perception defined below), neither of which election officials are required to be screened for under Texas law and

guidance regarding signature comparison. Both impact an individual's ability to make accurate handwriting authenticity determinations.

29. The Signature Verification Committee is only required to compare a ballot application signature with the carrier envelope signature. This small sample size is simply insufficient to account for variations in signatures by the same person.

30. At minimum, more signature samples than those required by Texas's Election Code—which only requires two: (i) the signature on the application to vote by mail, and (ii) the ballot envelope signature—are usually required for an accurate determination as to whether various signatures belong to the same person, to account for an individual's signature variability.[3] However, this minimum amount should be higher in cases where the writer is ill, disabled, elderly, or has other handwriting issues.

31. In sum, it is my opinion that Texas's current signature matching rules and procedures, which allow individuals without adequate training—and without guidance—to reject mail-in ballots and ballot applications for signatures they deem to be non-matching, will result in a significant number of erroneous rejections.

IV. ANALYSIS AND OPINIONS

A. Texas Election Officials are likely to make erroneous signature comparison determinations.

32. Individuals untrained in signature examination, like Texas election officials, are very likely to make mistakes when comparing signatures and are particularly likely to reject signatures erroneously as inauthentic or non-matching when they are in fact written by the same individual.

[3] Hilton, O. (1965). A further look at writing standards. *The Journal of Criminal Law, Criminology and Police Science*, Vol. 56, No. 3, p. 383.

These rejections are considered "Type II" errors,[4] and laypersons are more likely than FDEs to make such errors for several reasons. *First*, untrained election officials cannot reliably determine whether signatures are written by different individuals or whether the signatures are written by one person but exhibit natural variations. *Second*, untrained reviewers do not account for the many reasons for naturally varying signatures, causing them to erroneously reject authentic signatures. This is particularly true for writers who are poorly educated, learned English as a second language, elderly, disabled, young, or have health conditions. *Third*, untrained elections officials also fail to account for the different signature styles and features, leading to erroneous rejections. *Lastly*, Texas election officials are not tested for form blindness, a condition that impacts their ability to accurately review signatures.

i. Untrained laypersons are more likely than FDEs to erroneously determine authentic signatures are inauthentic.

33. There are two types of errors in signature examination. Type I errors occur when a non-genuine signature is deemed to be genuine, and a Type II error occurs when a genuine signature is concluded to be non-genuine.

34. Compared to individuals trained in handwriting examination, laypersons have higher so-called Type II error rates. In a 2001 study reviewing the error rates of FDEs and laypersons in comparing six genuine signatures with six non-genuine signatures, laypersons made Type II errors in 26.1% of cases while trained signature FDEs made such errors in 7.05% of cases.[5] That means that laypersons are more than 3 ½ times more likely to declare an authentic signature non-genuine—which, in the case of signatures on mail-in ballots and ballot applications, would mean

[4] *Infra* paragraph 33.

[5] Kam M., Gummadidala K., Fielding G., Conn R. (2001). Signature Authentication by Forensic Document Examiners. *Journal of Forensic Science*, 46(4):884-888.

that election officials would reject more than 3 ½ times the number of ballots and applications than individuals who have received training in handwriting examination. It should be noted that for this study, six specimen signatures were used. If, as in Texas elections, only one genuine signature is used for comparison, it is highly likely that the error rate for both experts and laypersons would increase significantly.

35. This study also found that laypersons are much more likely to make Type II errors than Type I errors, although laypersons are still substantially more likely to make Type I errors than individuals who have received training in handwriting examination (laypersons made Type I errors in 6.47% of cases while trained FDEs made such errors in 0.49% of cases).[6]

36. Similarly, a study conducted in Australia found that individuals trained in handwriting examination were statistically better than laypersons in determining genuineness or non-genuineness. The FDE group had a 3.4% error rate while the laypersons had a 19.3% error rate.[7] It must be noted that these error rates occurred when adequate signature samples were available. It can safely be assumed that the error rate will rise when an adequate number of comparison signatures are not available to the screener.

ii. Texas election officials cannot reliably determine whether signatures are written by different individuals or by one individual and exhibit natural variations.

37. Determining whether signatures are made by the same or different individuals requires a reviewer to discern whether a feature or combination of features in signatures are "differences" or "variations." Variations are deviations among repetitions of the same handwriting characteristic(s) that are normally demonstrated in the habits of each writer. In contrast, a

[6] *Id.*

[7] Sita, J., Found, B., & Rogers, D. (2002). *Forensic handwriting examiners expertise for signature comparison*. J. Forensic Sci. 47(5).

significant difference is an individualizing characteristic that is structurally divergent between handwritten items, that is outside the range of variation of the writer, and that cannot be reasonably explained.[8]

38. In the field of signature examination, unexplainable "*differences*" between signatures suggest that different individuals wrote the signatures, whereas "*variations*" between signatures mean that one individual wrote the signatures. Determining whether signature features are "differences" or "variations" is one of the most difficult determinations in signature examinations.

39. To make such a judgment reliably requires, at a minimum:

- Extensive training with different types of signatures: Becoming an FDE requires at least two, and typically three, years of full-time training with an experienced examiner, with at least eighteen months of training in the examination of signatures and handwriting. FDEs learn the science of signature examination, gain experience in casework, and are tested for proficiency.
- Adequate magnification and lighting equipment.
- Excellent eyesight.
- Adequate time: Insufficient time examining signatures is conducive to making errors. For example, one study found that FDEs spent more time looking at the questioned and known signatures than laypersons, and their evaluations were more

[8] Scientific Working Group for Documents Standard for the Examination of Handwritten Items (www.swgdoc.org).

accurate.[9] It can take two hours to compare a signature to an adequate number of samples.

40. Without these elements, Texas election officials are likely to misconstrue legitimate and expected "variations" between one individual's signatures for "differences" in signatures between two individuals, and conclude incorrectly that someone other than the registered voter signed the mail-in ballot or ballot application.

41. An individual's signatures may vary for myriad reasons, and to properly determine whether signatures are written by the same individual, one must consider the various reasons why features of the same individual's signatures may visually appear different. In one of the leading textbooks on handwriting examination, authors Roy Huber & A.M. Headrick identified twenty common reasons why individuals' signatures may appear to show variations:

- Adequacy of standards (or samples)—inadequate standards in terms of quantity and contemporaneousness will not be representative of the writer's range of variation. Variations may therefore be interpreted as differences.
- Accidental occurrences—i.e., these are one-off variations that will not appear in the specimen signatures.[10] Misinterpretation may lead to a decision of difference versus variation.
- Alternative styles—i.e., some writers have alternate signature styles. This may not be represented in the specimens.

[9] Merlino, M., Freeman, T., Dahis, V., Springer, V., et al. (Jan. 2015). *Validity, Reliability, Accuracy, and Bias in Forensic Signature Identification*. Department of Justice Grant 2010-DN-BX-K271, Document 248565, https://www.ncjrs.gov/ pdffiles1/nij/grants/248565.pdf.

[10] A specimen signature is a signature that is known to have been written by a person. It is not disputed. Typical specimens are Driver's Licenses and Identification Cards.

- Ambidexterity.
- Carelessness or negligence.
- Changes in the health condition of writer.
- Changes in the physical condition of writer—e.g., fractures, fatigue, or weakness may alter features of an individual's signature.
- Changes in the mental condition or state of the writer.
- Concentration on the act of writing.
- Disguise or deliberate change.
- Drugs or alcohol.
- Influence of medications.
- Intentional change for later denial (for example, signing a check with intent to later deny having written the signature).
- Nervous tension.
- Natural variations—i.e., inherent variation as a result of fluctuations in neuro-muscular coordination.
- Writing conditions—e.g., the individual's place or circumstances, such as in a moving vehicle or at a stationary table.
- Writing instrument—e.g., a pen versus a stylus.
- Writing position—e.g., the individual's stance.
- Writing surface—e.g., paper versus electronic screen.
- Writing under stress.

Examiners must consider each of these reasons in determining whether a feature is a "difference" created by different writers or whether the feature is simply a "variation" from the same writer. It

is very unlikely that a Texas election official will have the knowledge, training, and experience to properly account for these factors.

42. In particular, laypersons are significantly more likely than individuals trained in handwriting examination to incorrectly reject authentic signatures of illiterate writers,[11] writers for whom English is a second language, elderly writers, disabled writers, and writers with health conditions[12,13] to be non-genuine. Studies have shown that these types of writers tend to have less pen control than most other writers, and therefore would have a greater range of variation in their signatures. And the increased variation in the signatures of these groups only compounds laypersons' tendencies to err on the side of incorrectly finding authentic signatures to be non-genuine.

43. Since signatures are developed as a motor program in the brain,[14] the signatures of writers for whom English is a second language are more likely to exhibit wide ranges of variation, as these writers will have to discard their former learned motor program and develop a new one for their new signature style. For instance, a writer who first learned to write in a non-Latin-based script, such as Chinese, will naturally show more variation when signing a document in English than a native writer. Likewise, where the writer's native language is written right to left, such as Urdu, the writer's signature may also be more likely to show variations in letter slanting. Qualified, experienced experts in the area of signature verification would know and account for these factors

[11] Hilton, O. (1965). A further look at writing standards. Journal of Criminal Law, Criminology, and Police Science, Vol. 56, No. 3, pp.383.

[12] Hilton, O. (1956). Influence of serious illness on handwriting identification. Postgraduate Medicine, Vol. 19, No. 2.

[13] Hilton, O. (1969). Consideration of the writer's health in identifying signatures and detecting forgery. Journal of Forensic Sciences, Vol. 14, No. 2, pp. 157-166.

[14] Mohammed, L. (2019). Forensic Examination of Signatures. Elsevier: San Diego, pp. 5-16.

in evaluating signatures; Texas election officials, even if put through a short training session, are unlikely to be able to accurately account for these differences, particularly in an expedient time frame or when only one or a few specimen signatures are available for comparison.

44. Furthermore, young voters (ages 18 to 25) are not likely to have fully developed signatures. According to Huber & Headrick (1999), "the development and progress of one's handwriting passes through four stages in the course of a lifetime: (1) the formative stage, (2) the impressionable or adolescent stage, (3) the mature stage, and (4) the stage of degeneration."[15] The signatures of young voters will fall between stages 2 and 3. The U.S. Postal Service has reported that "writer[s] achieve graphic maturity by the 20th birthday."[16] Handwriting was developed as a means of communication,[17] whereas signatures are developed as a means of identification.[18] Signatures tend to be more personalized and can therefore be considered as an over-developed form of handwriting. It follows that young writers today will not have developed signatures until later in life. This is exacerbated as young writers will presumably need to sign less often due to the increased use of personal identification numbers ("PINs") and other non-handwritten forms of identification. Their signature development can reasonably be expected to take longer than for previous generations. This will lead to an increased range of variation in a young writer's signature. The handwriting of adolescents can cause difficulties even for trained FDEs. Comparisons by

[15] Huber, R.A. & Headrick, A.M. (1999). *Handwriting Identification: Facts and Fundamentals*. Boca Raton, FL: CRC Press.

[16] Bureau of the Chief Postal Inspector (1966), *20th Century Handwriting Systems and Their Importance to the Document Analyst*.

[17] Plamondon, R., Srihari, S. (2000). Online and off-line handwriting recognition: a comprehensive survey. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Volume: 22, Issue:1, Jan.

[18] Srihari S.N., Srinivasan H., Chen S., Beal M.J. (2008). Machine Learning for Signature Verification. In: Marinai S., Fujisawa H. (eds) Machine Learning in Document Analysis and Recognition. *Studies in Computational Intelligence*, Vol 90. Springer, Berlin, Heidelberg, p. 389.

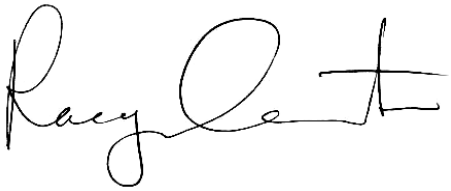
untrained individuals of young voters' signatures on mail-in ballot applications and return envelopes will exacerbate the potential for error in rejecting their ballots.[19]

iv. Texas elections officials also fail to account for the different signature styles and features, leading to erroneous rejections.

45. One of the reasons that accurate signature comparison determinations prove difficult is that signatures are written in three different styles[20]:

- Text-based: Nearly all the letters can be interpreted.

- Mixed: More than two, but not all, letters can be interpreted.



- Stylized: No letters can be interpreted.

These signature styles exhibit significantly different characteristics that impact the signature-matching analysis, and by extension, the determination of whether signatures are genuine. For example, kinematic features of signatures, such as size, velocity, changes of acceleration, and pen

[19] Cusack, C.T & Hargett, J.W. (1989). A Comparison Study of the Handwriting of Adolescents. *Forensic Science International*, 42(3):239-248.

[20] Mohammed, L., Found, B., Rogers, D. (2008). Frequency of signature styles in San Diego County. *Journal of the American Society of Questioned Document Examiners*, Vol. 11, No. 1.

pressure are important in determining whether a signature is genuine. Yet these kinematic features vary between the same individual's signatures, with the degree of variations often dependent on the signature style. The kinematic features of stylized signatures, for example, vary more significantly than the kinematic features of text-based signatures. And the less legible a signature becomes, the more the election official depends on their pattern recognition ability. Thus, signature styles can have an impact on the determination of genuineness or non-genuineness. Unfamiliarity with the different signature styles may impact a reviewer's ability to determine whether two signatures come from the same person, and would likely cause a lay person to decide that the compared signatures exhibit "differences" when the changes in features are simply "variations."

46. To determine whether signatures are made by the same individual, a reviewer should focus on holistic features of signatures, such as alignment, slant, pen lifts, rhythm, the size of writing, the slope or slant of the letters, or other characteristics that are diagnostic of the process used to create signatures. These features are subtle, and a writer is usually unaware of the features, as they are excited by the writer's subconscious motor program. These subtle features provide significant evidence of genuineness because they occur in natural handwriting. Lay persons, however, often focus instead on more eye-catching features in evaluating signatures. For example, an eye-tracking study on signature examination found that "lay participants focused to a greater extent on individual features such as arches, eyelets, hooks, shoulders, connections, troughs, or other individual features" that catch the eye, and "appear[ed] less likely to use holistic features."[21] But focusing on these eye-catching features is problematic because these are the types of features that a simulator will try to capture. Properly utilizing the subtle, holistic features of signatures to determine genuineness, however, requires both training and adequate time for review.

[21] Merlino, *supra* note 9.

v. Texas election officials are not tested for form blindness, increasing the risk of erroneous signature match determinations.

47. A laypersons' ability to make consistently correct determinations as to the genuineness of a signature may also be impacted by a condition known as "form blindness," which impairs "the ability to see minute differences in angles, forms, and sizes."[22] Most ophthalmologists agree that form perception is not an eye problem but rather a translational problem. That is, "it is a perceptual inability to distinguish the small differences between shapes, colors, and patterns."[23] Therefore, in most cases, form blindness goes undetected, but diminishes a reviewer's ability to make accurate determinations of a signature's genuineness.[24] And while FDEs must pass a form blindness test[25] before being trained in handwriting identification, Texas requires no such test for election officials. There is thus a risk that some election officials have form blindness and are particularly prone to making erroneous signature determinations.

B. Even trained FDEs are likely to make erroneous signature comparison determinations under Texas's signature matching procedures.

48. Even for trained FDEs, Texas's signature matching process would be prone to erroneous determinations due to the limited number of comparison signatures and the lack of proper equipment.

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[22] Bertram, D. (2009). Univ. of S. Miss. *Form Blindness Testing: Assessing the Ability to Perform Latent Print Examination by Traditional Versus Nontraditional* Students Dissertations. 996, p. 33; Byrd, J. & Bertram, D. (2003). Form-Blindness. *Journal of Forensic Identification*, 53(3):315-341.

[23] Moody, Meredith G., "*Form-Blindness and Its Implications: A Verification Study*" (2016); Honors Theses; Paper 388.

[24] *Id.*, p. 32.

[25] Osborn, A.S.(1946). Questioned Document Problems 2nd. Ed., Boyd Printing Company, pp. 231-250.

49. Normally, FDEs require more specimen signatures for comparison with a questioned signature than the Texas regulations require (which is just two: the application to vote by mail and the signed ballot envelope), and often even more if issues such as age or illness are involved. These specimens are required to adequately determine the range of variation of the writer and properly account for the reasons for variation within an individual's signatures discussed above. Indeed, no two complex, skillfully written, genuine signatures of one writer have ever been found to be exactly alike (such a statement should be understood to be true speaking microscopically, and not as the carpenter measures).[26] This is so because signatures are the product of a motor program developed in the brain after practice and then executed with neuro-muscular coordination, and many factors can influence an individual's motor program and neuro-muscular coordination, including the factors discussed above. Inadequate standards, or failure to use adequate specimens fully representing the range of variation in a writer's signature, is well-known source of error.[27]

50. Features observed in the questioned signature(s) may not be observed in the inadequate specimens. This may lead to an erroneous interpretation of a feature as a difference (two writers) or variation (one writer). Because Texas election officials are only required to compare the signature on the mail-in ballot application with the ballot return envelope, they cannot distinguish accurately between features, variations, or differences. Although they may compare the ballot envelope with other samples, the regulations do not appear to require them to do so.

[26] Osborn, A. (1910). Questioned Documents. The Lawyers' Publishing Co.: Rochester, NY, p. 281.

[27] Huber, R.A. & Headrick, A.M. (1999). *Handwriting Identification: Facts and Fundamentals*. Boca Raton, FL: CRC Press.

51. Furthermore, in many instances, Texas election officials may compare a voter's original "wet-ink" signature on the ballot return envelope with electronic copies of the signature on the mail-in ballot application.

52. Comparing a digitized signature with an original "wet-ink" signature has many inherent limitations, some of which are caused by the resolution of the digitized signature, whether the digitized signature is being viewed on a monitor or as a printed item, and the writing instruments used for each signature. If the resolution on a monitor is low, or if the digitized signature is a poor copy of the original signature to begin with, this would make it very difficult for an untrained examiner to assess the line quality of the signature.

53. Finally, as discussed above, Texas does not require election officials to use or be provided with proper equipment, such as magnification and lighting equipment. "[T]he microscope is the instrument which makes it possible to see physical evidence directly that otherwise may be invisible. . . ."[28] Without this type of equipment, even a well-trained eye may make errors in a signature authenticity determination.

V. CONCLUSION

54. Based on the studies cited above laypersons have significantly higher error rates than individuals trained in determining signature authenticity. These tests were conducted under conditions where the participants had adequate specimens, lighting, time, and examination equipment. For the reasons stated herein, it is my professional opinion that there is a high likelihood that Texas election officials will make erroneous signature match determinations given the limited specimens and equipment they have to conduct the signature verifications.

[28] Osborn, A. S. (1929). *Questioned Documents. 2nd. Ed.* Boyd Printing Company, Albany, N.Y., USA.

55. In particular, Texas election officials are significantly more likely to erroneously conclude that authentic signatures are *not* genuine than they are to make the opposite error—to accept inauthentic signatures as genuine. These erroneous determinations result from the inherent difficulty in making reliable signature authenticity determinations, particularly where, as here, the reviewer lacks training, is provided with an insufficient number of comparison signatures, and does not have access to proper equipment. The use of digitized signatures as a reference sample for comparison with an original "wet-ink" signature will most likely exacerbate the error rate. In this context, Texas's signature matching procedures are all but guaranteed to result in the erroneous rejection of mail-in ballots.

* * *

I declare under penalty of perjury that the forgoing is true and correct.

Dated: June 22, 2020 at Burlingame, CA.

Linton Mohammed, Ph.D., D-ABFDE